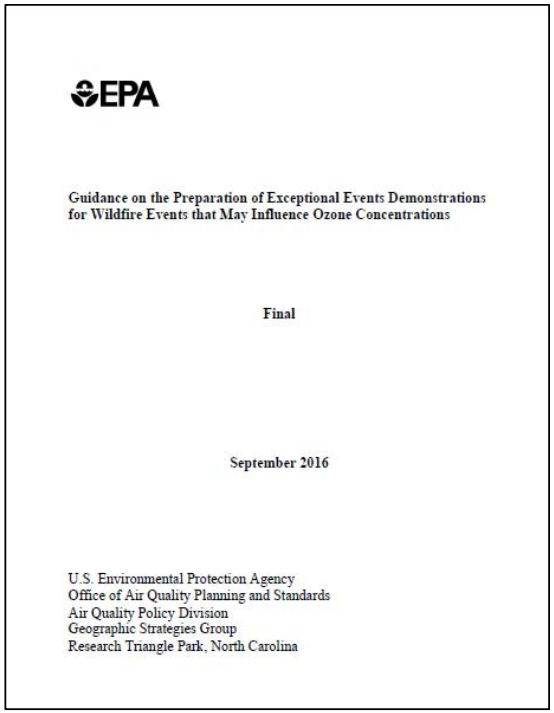
EXCEPTIONAL EVENTS UPDATES
Case Study: Wildfire Ozone

Michael Flagg
Air Quality Analysis Office, Region 9 – U.S. EPA
Exceptional Events Workshop
November 2016

Overview

- Initial Notification Process
- Components of a Wildfire Ozone Demonstration
  - Conceptual Model
  - Clear Causal Relationship
- Examples of Evidence and Analysis
  - Tier I
  - Tier II
  - Tier III


EPA

Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations

Final

September 2016

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Air Quality Policy Division
Geographic Strategies Group
Research Triangle Park, North Carolina

For illustration and discussion purposes only

Initial Notification: Washoe County, Nevada

Communication tool used to assess regulatory significance and critical path analysis

- Applicable NAAQS
- Affected Regulatory Decision
- Area Name/Designation Status
- Design Value Period
- Event Narrative
- Event Specific Concentrations
- Design Value Calculations

For illustration and discussion purposes only

Initial Notification: Washoe County, Nevada

Initial Notification of Potential Exceptional Event Information Summary

Submitting Agency: Washoe County Health District, Air Quality Management Division
Agency Contact: Daniel Inouye, Branch Chief
Date Submitted: June 3, 2016
Applicable NAAQS: 2006 24-Hour $PM_{2.5}$ and 2015 8-Hour Ozone
Affected Regulatory Decision[1]: Attainment of the 2015 8-Hour Ozone NAAQS
Area Name/Designation Status: Washoe County Attainment Area
Design Value Period: 2013-2015

Narrative: On August 18, 2015 smoke from numerous wildfires in the Northwest portion of California impacted the Reno/Sparks area. The smoke impacts contributed to several exceedances of the National Ambient Air Quality Standards (NAAQS) for Particulate Matter less than or equal to 2.5 microns in aerodynamic diameter ($PM_{2.5}$) and Ozone (O_3) at several sites in the Washoe County Health District, Air Quality Management Division's (AQMD) monitoring network. The AQMD requests that the Regional Administrator for Region IX of the U.S. Environmental Protection Agency (EPA) accepts this Initial Notification so an Exceptional Events Demonstration document can be prepared to petition for the exclusion of the air quality monitoring data effected from these fires from the normal planning and regulatory requirements under the Clean Air Act (CAA) in accordance with the Exceptional Events Rule (EER).

For illustration and discussion purposes only

Initial Notification: Washoe County, Nevada

Table A (1):
Information specific to each flagged site day that may be submitted to EPA in support of the affected regulatory decision listed above.

Date(s) of Event	NAAQS Standard	Type of Event (high wind, volcano, wildfires/prescribed burns, other)	AQS Flag	Site AQS ID	POC	Site Name	Monitor Concentration
08/21/2015	$PM_{2.5}$	Northwest Wildfires	RT	32-031-0016 32-031-1005	3 1	Reno3 Sparks	38.8 $\mu g/m^3$ 39.2 $\mu g/m^3$

*Data was flagged in AQS on 04/14/2016 and 05/03/2016 as Wildfire Event from 08/18/2015 (00:00) to 08/21/2015 (23:59)

Table A (2):
Information specific to each flagged site day that may be submitted to EPA in support of the affected regulatory decision listed above.

Date(s) of Event	NAAQS Standard	Type of Event (high wind, volcano, wildfires/prescribed burns, other[2])	AQS Flag	Site AQS ID	POC	Site Name	Monitor Concentration
08/18/2015	Ozone	Northwest Wildfires	RT	32-031-0016	1	Reno3	0.075 ppm
				32-031-1005	1	Sparks	0.070 ppm
				32-031-0025	1	Toll	0.068 ppm
				32-031-0020	1	South Reno	0.073 ppm
				32-031-2009	1	Lemmon Valley	0.069 ppm
				32-031-2002	1	Incline	0.063 ppm
08/19/2015	Ozone	Northwest Wildfires	RT	32-031-0016	1	Reno3	0.073 ppm
				32-031-1005	1	Sparks	0.071 ppm
				32-031-0025	1	Toll	0.069 ppm
				32-031-0020	1	South Reno	0.071 ppm
				32-031-2009	1	Lemmon Valley	0.067 ppm
				32-031-2002	1	Incline	0.061 ppm
08/20/2015	Ozone	Northwest Wildfires	RT	32-031-0016	1	Reno3	0.070 ppm
				32-031-1005	1	Sparks	0.069 ppm
				32-031-0025	1	Toll	0.070 ppm
				32-031-0020	1	South Reno	0.070 ppm
				32-031-2009	1	Lemmon Valley	0.068 ppm
				32-031-2002	1	Incline	0.061 ppm
08/21/2015	Ozone	Northwest Wildfires	RT	32-031-0016	1	Reno3	0.073 ppm
				32-031-1005	1	Sparks	0.072 ppm
				32-031-0025	1	Toll	0.073 ppm
				32-031-0020	1	South Reno	0.072 ppm
				32-031-2009	1	Lemmon Valley	0.067 ppm
				32-031-2002	1	Incline	0.064 ppm

For illustration and discussion purposes only

Initial Notification: Washoe County, Nevada

Table C (1):
Summary of Maximum Design Value (DV) Site Information for **24-Hour $PM_{2.5}$** (Effect of EPA Concurrence on Maximum Design Value Site Determination)

Maximum DV site (AQS ID) **without EPA concurrence** on any of the events listed in Table A (1) above	Design Value 32	Design Value Site Sparks (32-031-1005)	Comment
Maximum DV site (AQS ID) **with EPA concurrence** on all events listed in Table A (1) above	Design Value 32	Design Value Site Sparks (32-031-1005)	Comment

Table C (2):
Summary of Maximum Design Value (DV) Site Information for **8-Hour Ozone** (Effect of EPA Concurrence on Maximum Design Value Site Determination)

Maximum DV site (AQS ID) **without EPA concurrence** on any of the events listed in Table A (2) above	Design Value 71	Design Value Site Reno3 (32-031-0016)	Comment
Maximum DV site (AQS ID) **with EPA concurrence** on all events listed in Table A (2) above	Design Value 70	Design Value Site Reno3 (32-031-0016)	Comment

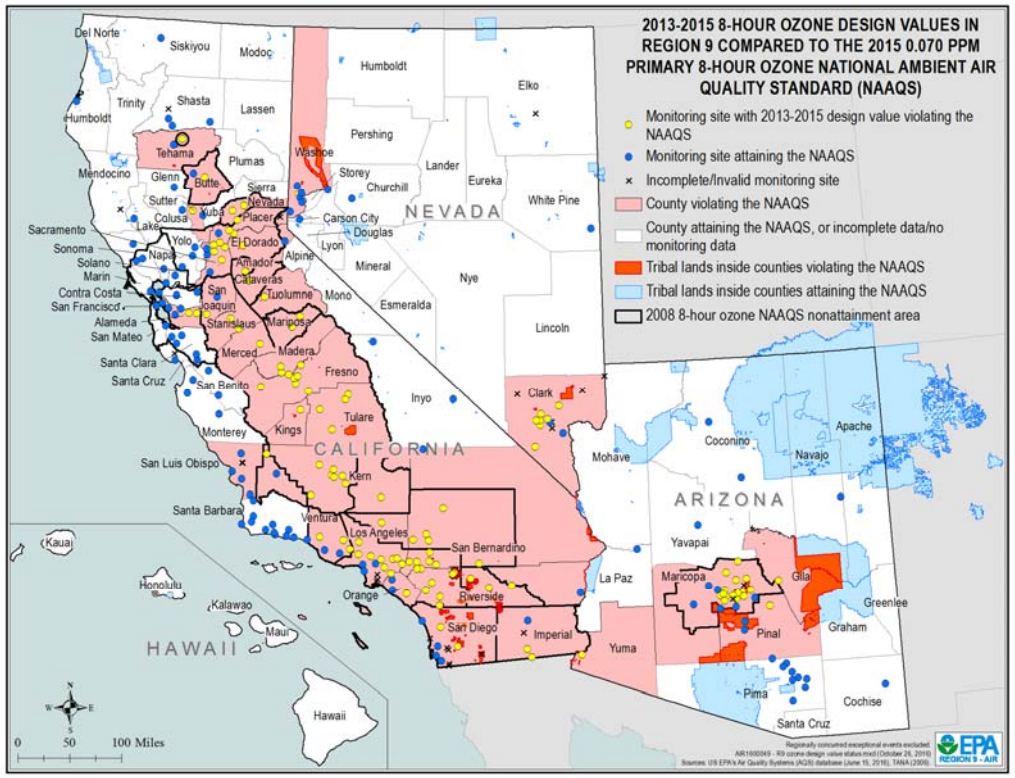
For illustration and discussion purposes only

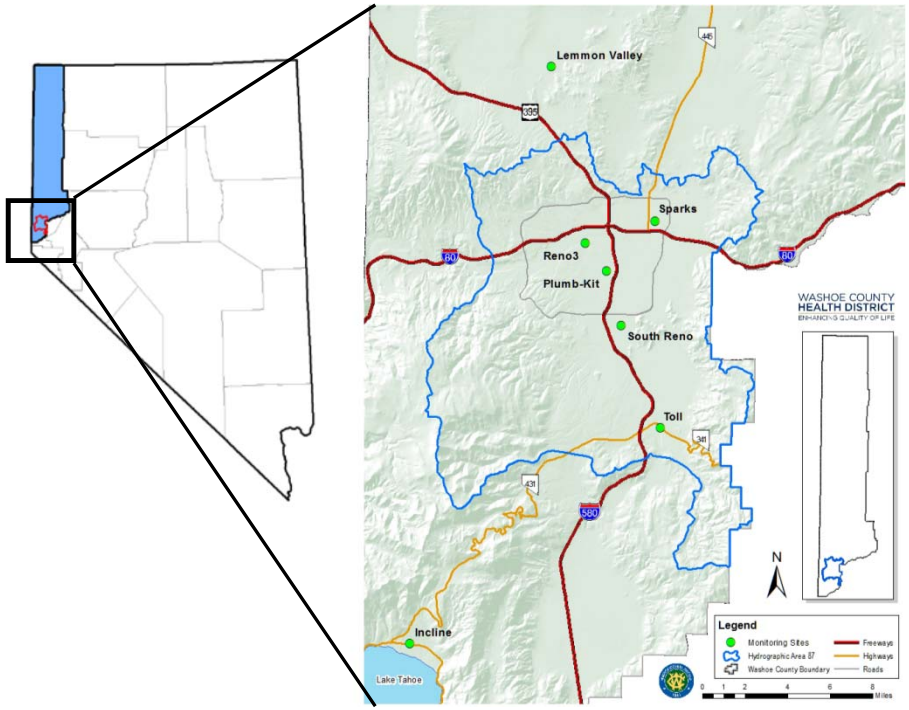
Conceptual Model

- Description of the geographic area
- Typical non-event O_3 formation and meteorology
  - Average O_3 daily profiles
  - Seasonal variation
- Summary of fires
  - Description of the 2015 wildfire season
  - Locations of specific fires
  - Fire maps
- Event specific O_3 concentrations

For illustration and discussion purposes only

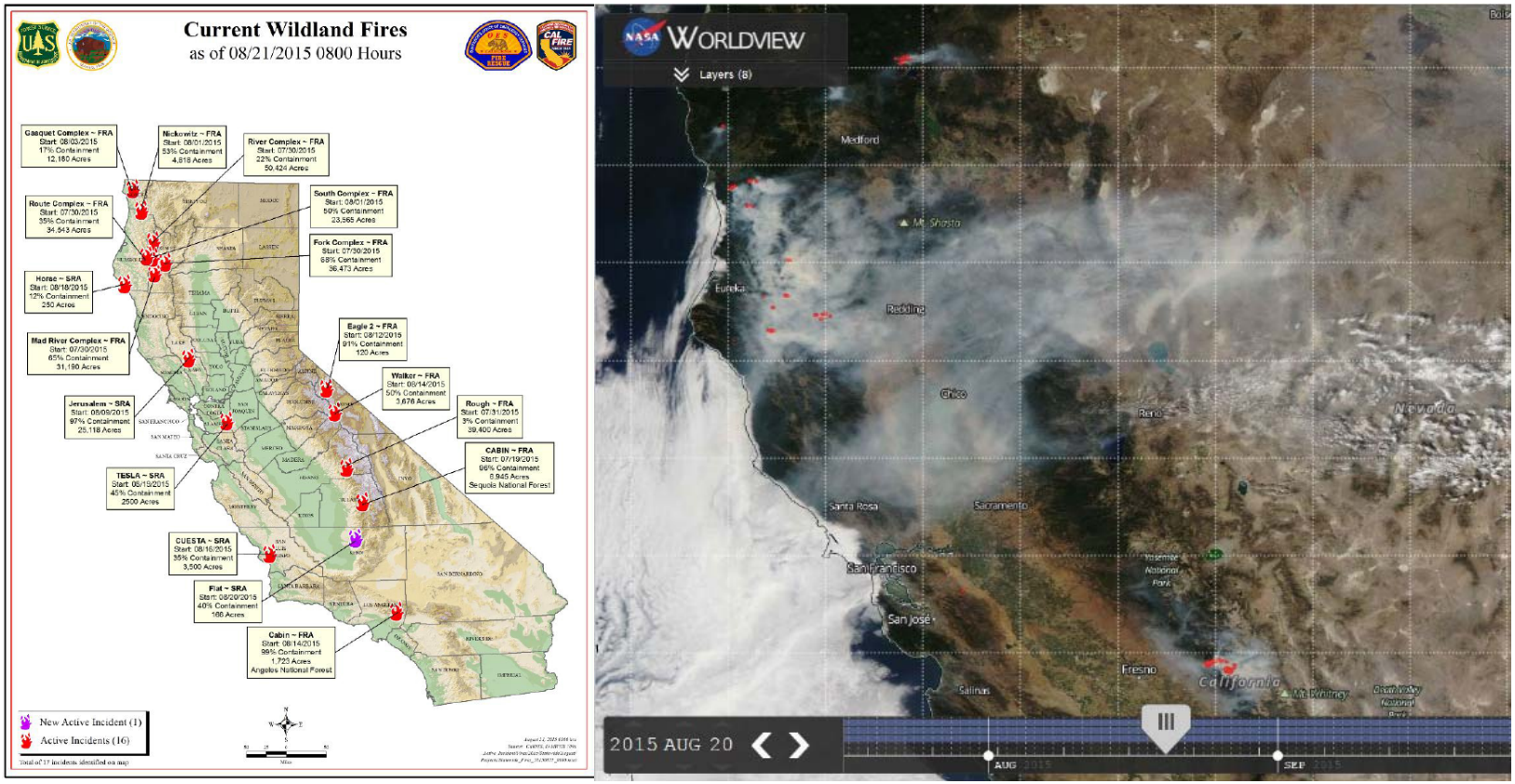
Conceptual Model





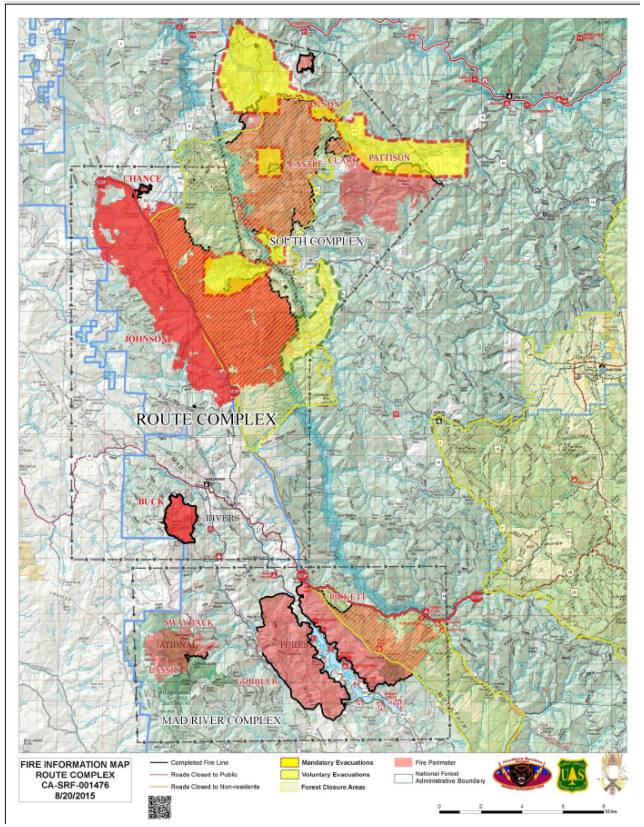
For illustration and discussion purposes only

Conceptual Model



For illustration and discussion purposes only

Conceptual Model



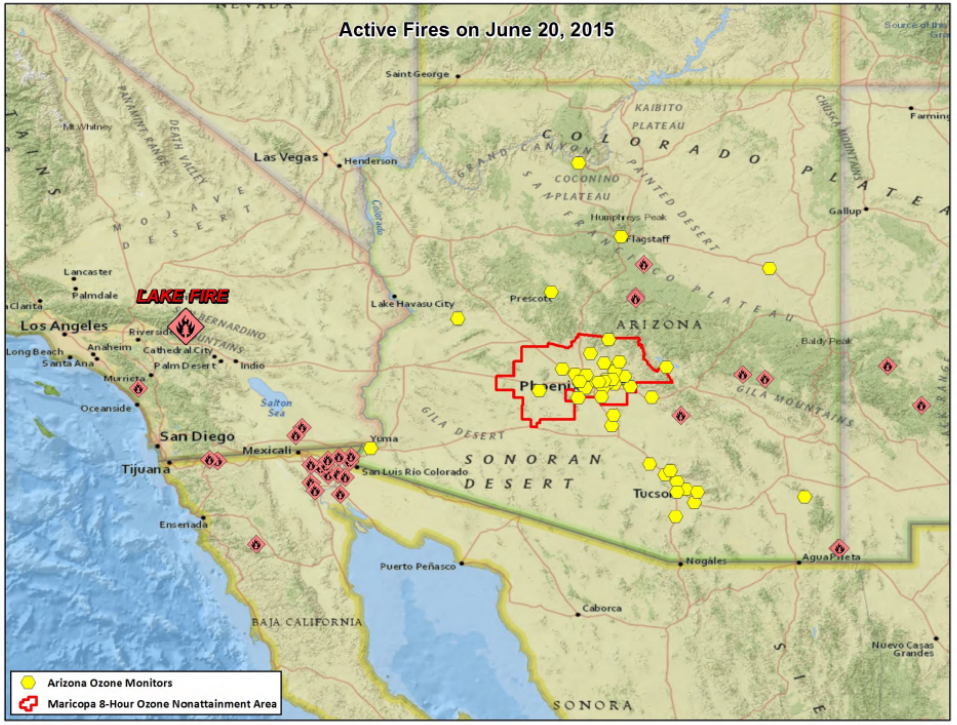


Figure 2-7. Active wildfires on June 20, 2015 in Arizona, southeastern California and northern Mexico.

For illustration and discussion purposes only

Tier I

Wildfire events that clearly influence O_3 exceedances or violations in areas that typically experiences lower O_3 concentrations. This tier is associated with an O_3 concentration that is clearly higher than non-event related concentrations, or occur outside of the area's normal O_3 season.

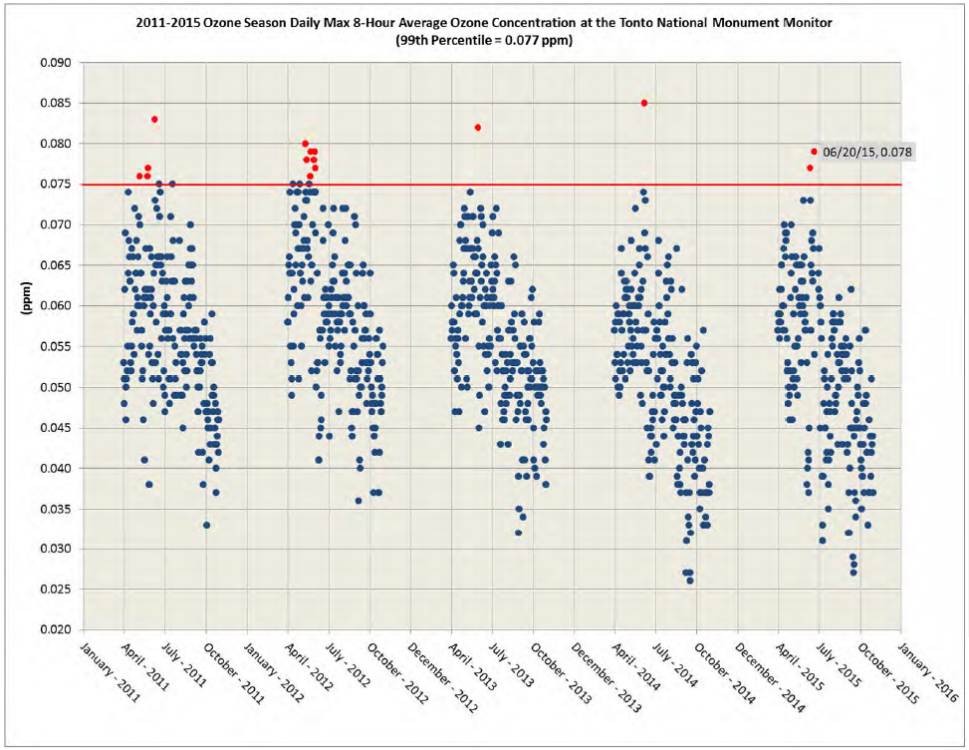
Key Factor

Seasonality or distinctive level of the monitored O_3 exceedance

- *Outside normal O_3 season*
- *5-10 ppb higher than non-event related concentrations*

For illustration and discussion purposes only

Tier I



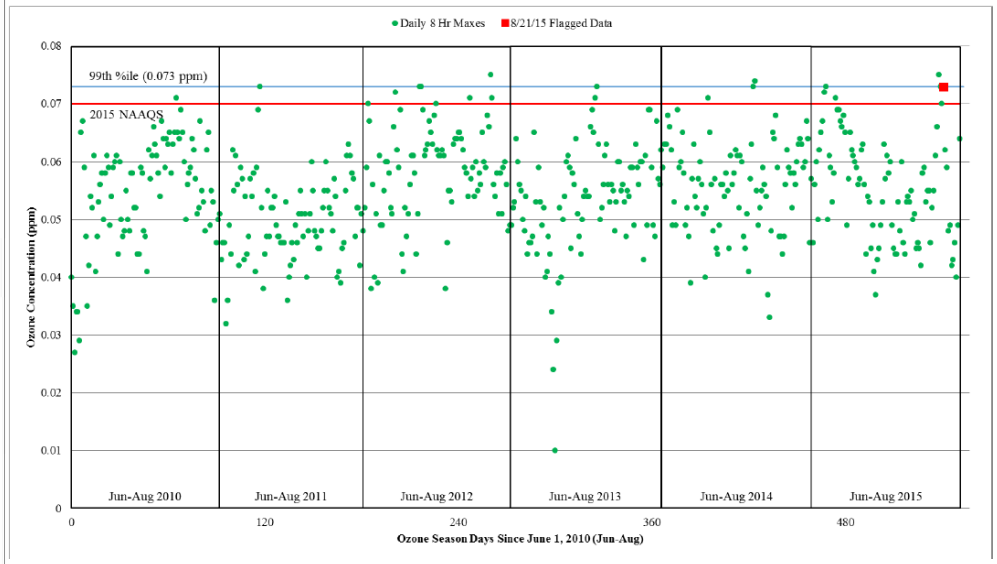
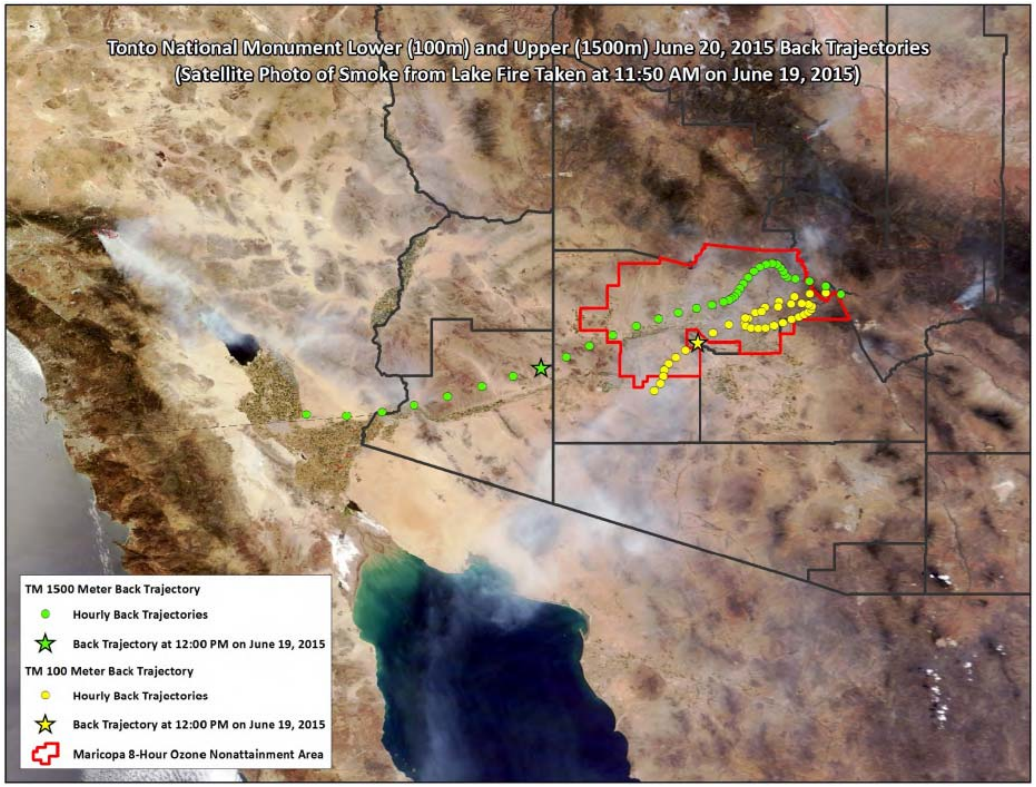


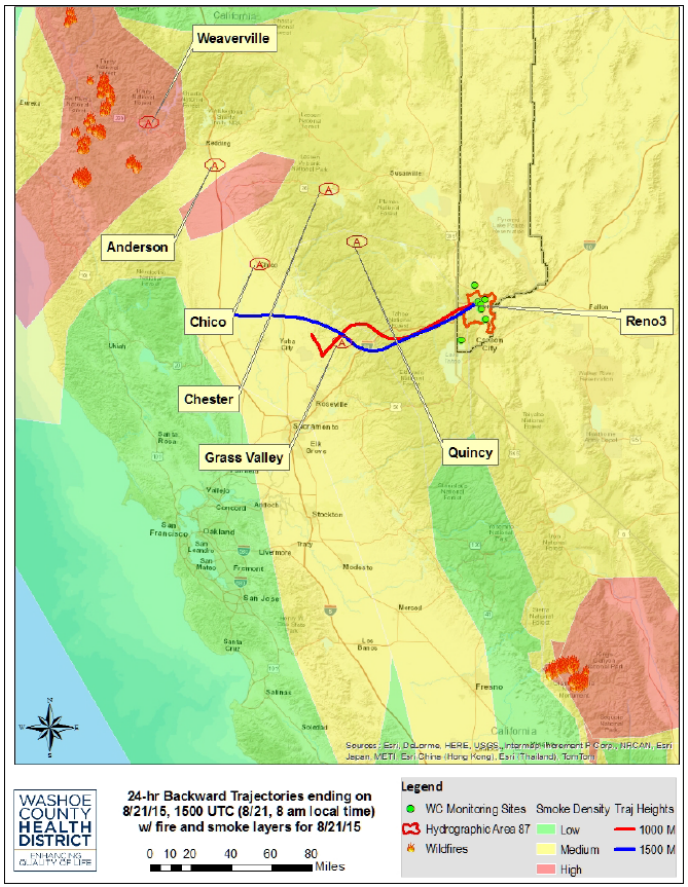
Figure 3-6. Plot of 5-year ozone season daily maximum 8-hour average concentrations at the Tonto National Monument monitor.

For illustration and discussion purposes only

Clear Causal Relationship: Tier I

(1) Trajectory Analysis (2) Satellite Imagery



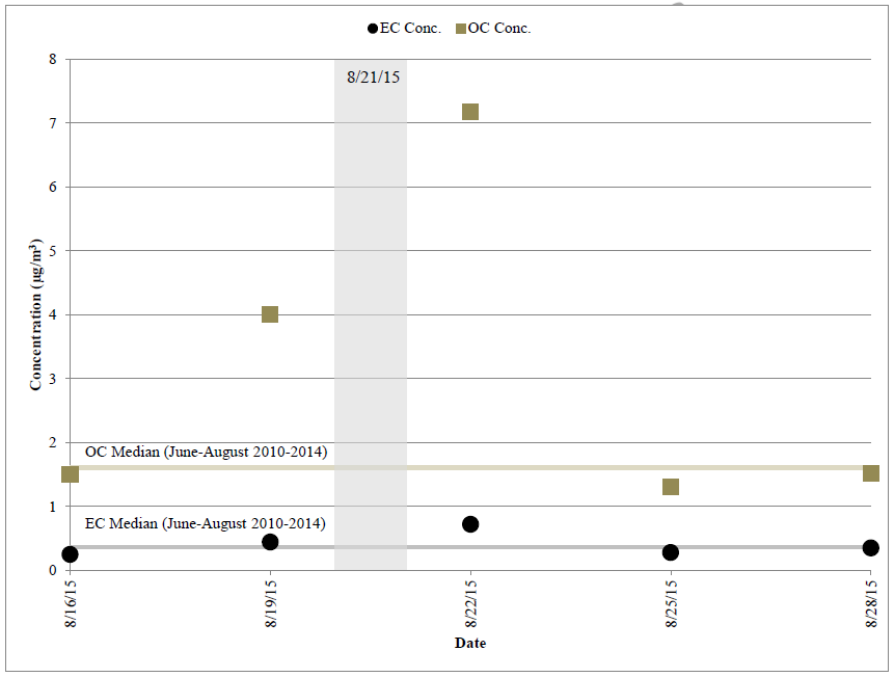


For illustration and discussion purposes only

Clear Causal Relationship: Tier I

(3) Evidence of the Plume Impacting the Ground

Figure 3.14: Elemental & Organic Carbon Concentrations during the 2015 Wildfires



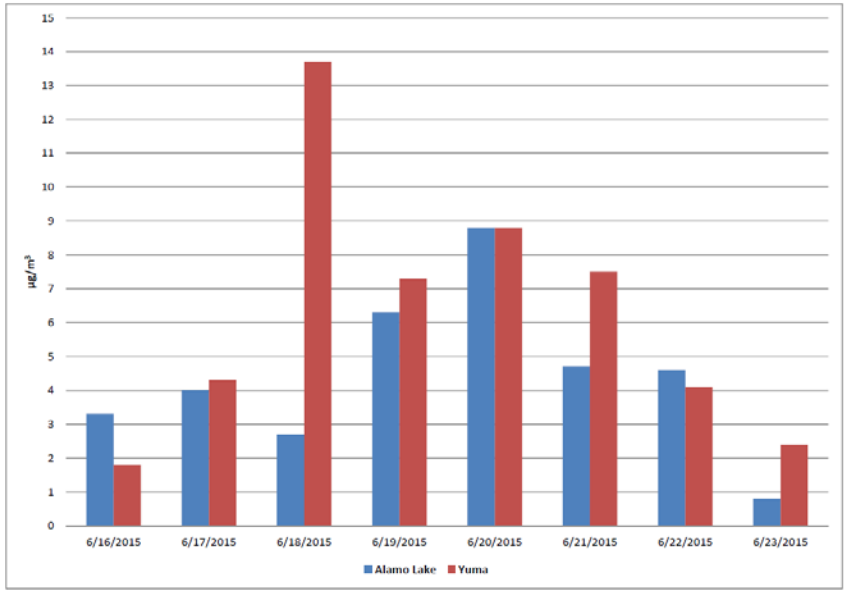


Figure 3-31. 24-Hour $PM_{2.5}$ concentrations at Alamo Lake and Yuma during June 16-23, 2015.

For illustration and discussion purposes only

Tier II

Wildfire events that do not meet the criteria of Tier I

Key Factor #1

Fire emissions and distance of fire(s) to affected monitoring site location

- *Q/D >= 100 tons/km*

Key Factor #2

Comparison of the event-related O_3 concentration with non-event high O_3 concentrations

- *99^{th} or higher percentile of 5-year distribution*
- *One of the four highest values within 1 year*

For illustration and discussion purposes only

Tier II

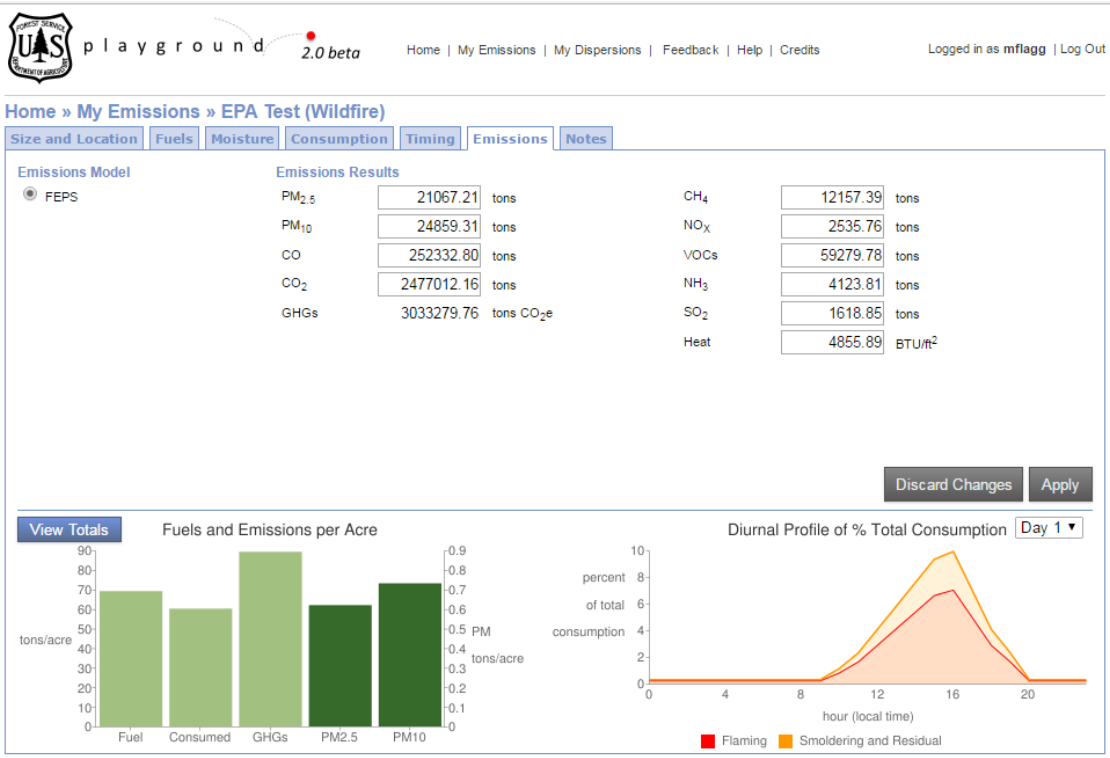


Table 3.1: Q/D Calculations for Seven Northwest Wildfires on August 20, 2015

Fire Name	Lat/Long	Distance (km)	Acres	Emissions (tons)	Q/D (tpd/km)
Fork Complex	40.45/-123.128	187	1,120		
Mad River Complex	40.34/-123.383	197	3,622		
South Complex	40.62/-123.448	207	290		
Route Complex	40.64/-123.586	215	1,391		
River Complex	40.91/-123.437	214	2,622		
Gasquet Complex	41.85/-123.969	271	3,563		
Nickowitz	41.47/-123.75	246	904		
Totals			13,512	24,566	86

Table 3.2: Q/D Calculations for Seven Northwest Wildfires on August 21, 2015

Fire Name	Start Lat/Long	Distance (km)	Acres	Emissions (tons)	Q/D (tpd/km)
Fork Complex	40.45/-123.128	187	188		
Mad River Complex	40.34/-123.383	197	1,106		
South Complex	40.62/-123.448	207	758		
Route Complex	40.64/-123.586	215	193		
River Complex	40.91/-123.437	214	2,325		
Gasquet Complex	41.85/-123.969	271	1,357		
Nickowitz	41.47/-123.75	246	152		
Totals			6,079	11,053	39

For illustration and discussion purposes only

Tier II

Figure 3.1: Reno3 8-Hour Daily Ozone Season Maximums June-August, 2010-2015

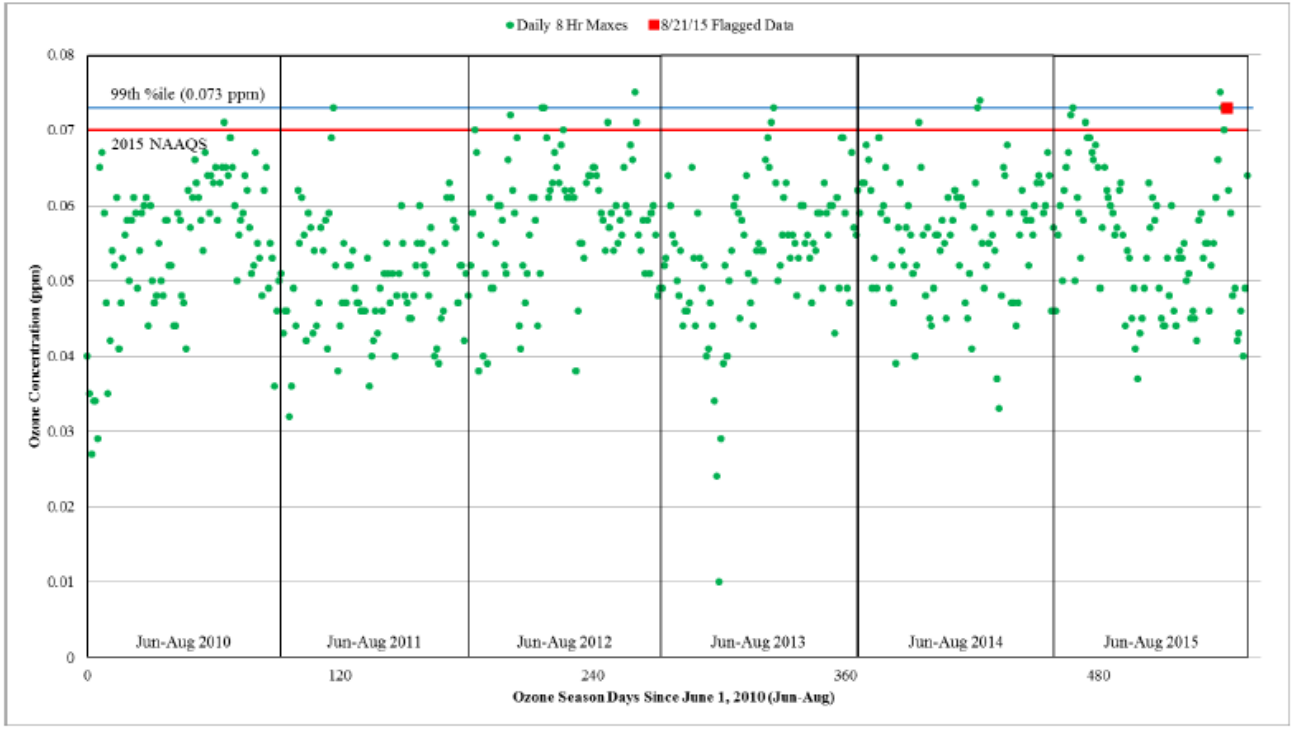


Table 1.3: Historic 8-hour Ozone Concentrations at Reno3

Percentile	Concentration (ppm)
100	0.075
99	0.073
95	0.068
50	0.055

For illustration and discussion purposes only

Clear Causal Relationship: Tier II

(1) Tier I Analysis

(2) Addition evidence that the emissions from the wildfire affected the monitored O_3 concentration

a) Evidence of changes in spatial/temporal patterns of O_3 and/or NOx

b) Photographic evidence of ground-level smoke at the monitor

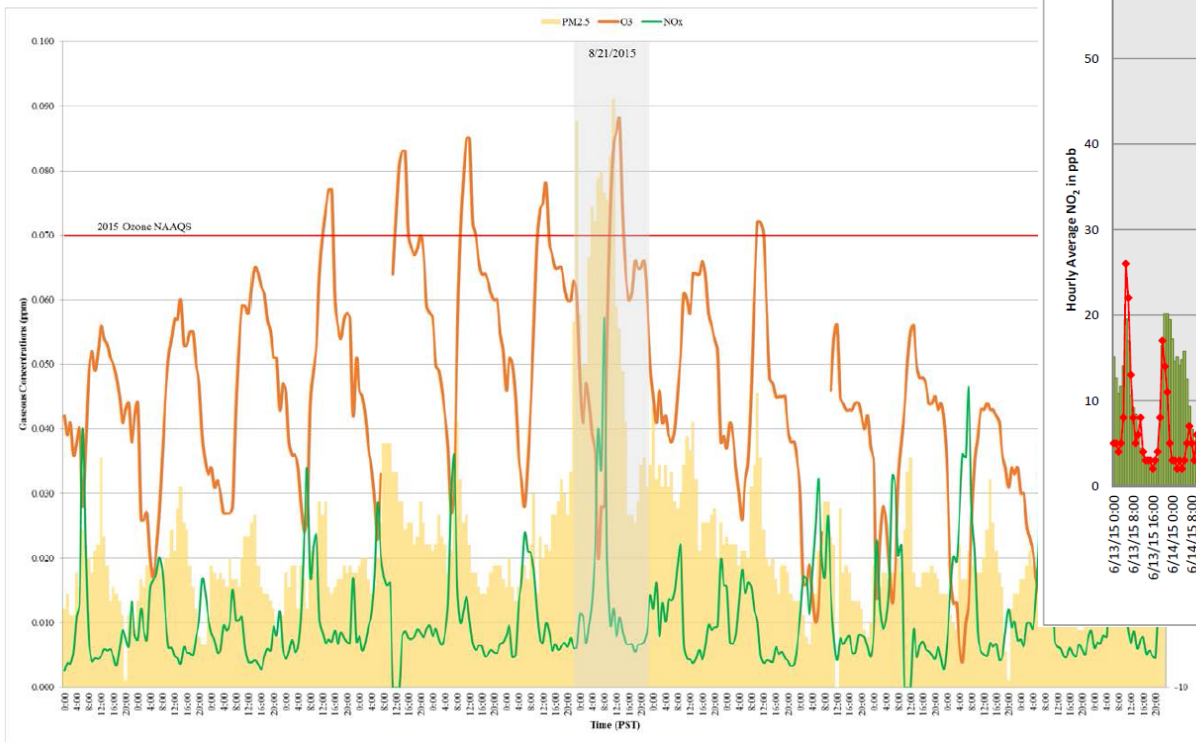
c) Concentrations of supporting ground level measurements

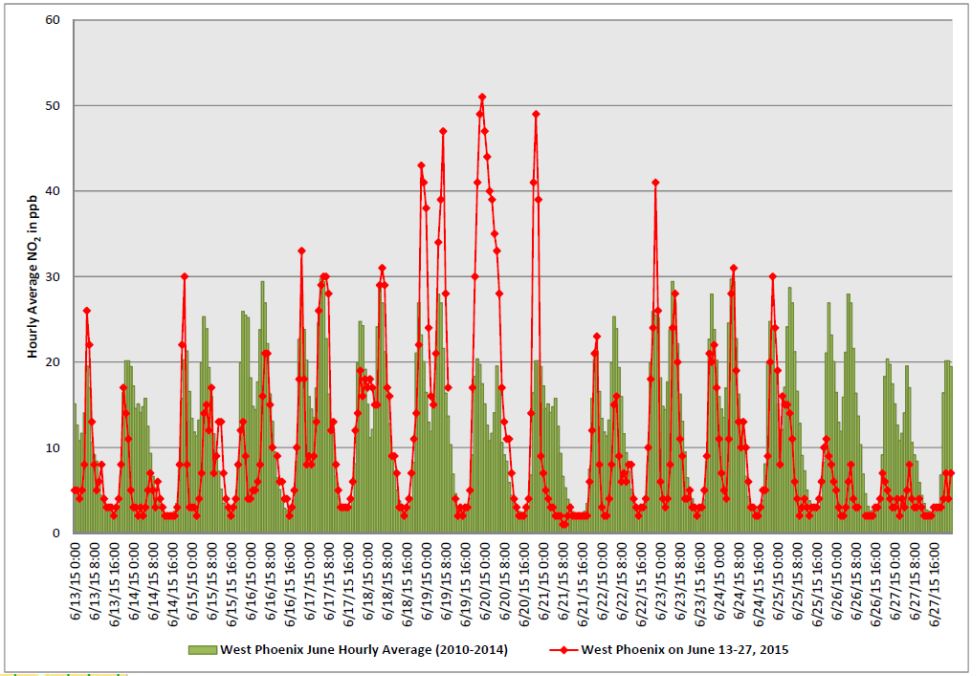
- CO
- PM (mass or speciation)
- VOCs
- Pollutant Ratios

For illustration and discussion purposes only

Clear Causal Relationship: Tier II, (2)(a),(2)(c)

Figure 2.7: Reno3 Ozone, NOx, and $PM_{2.5}$ Hourly Concentrations for August 14-28, 2015





For illustration and discussion purposes only

Clear Causal Relationship: Tier II, (2)(a)

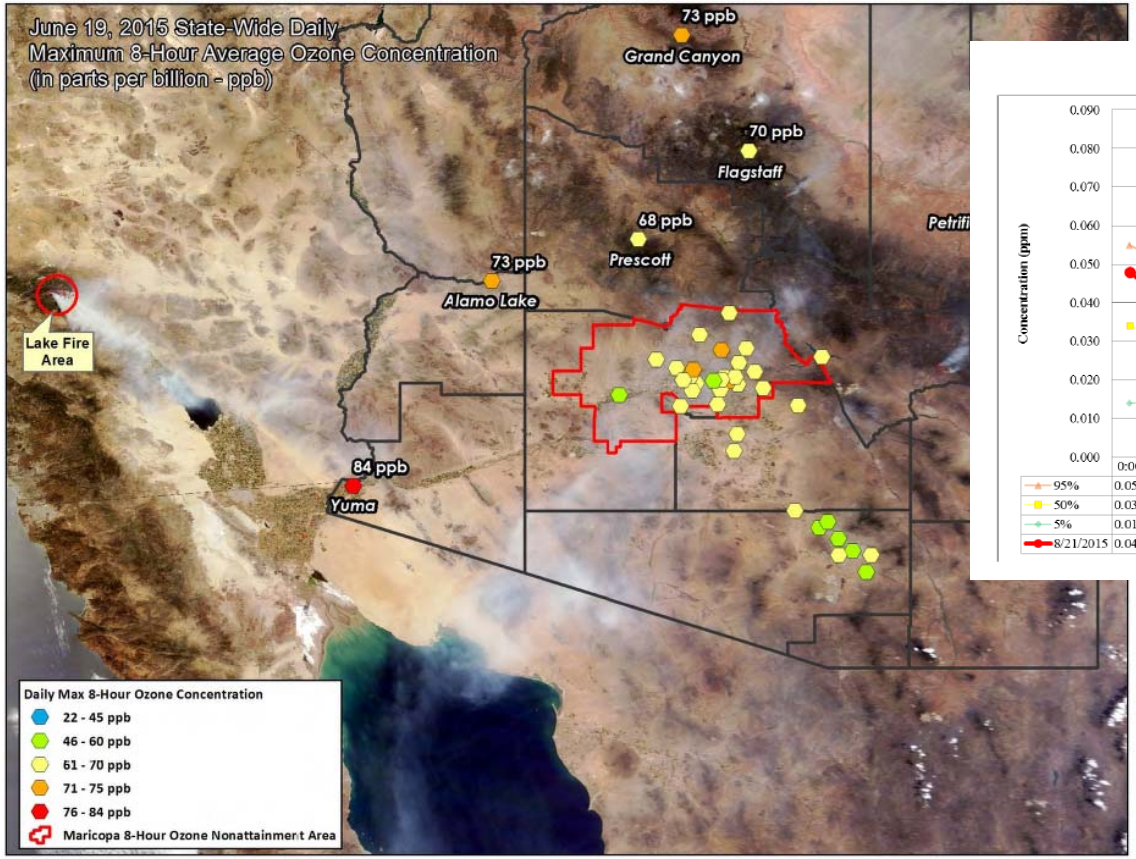
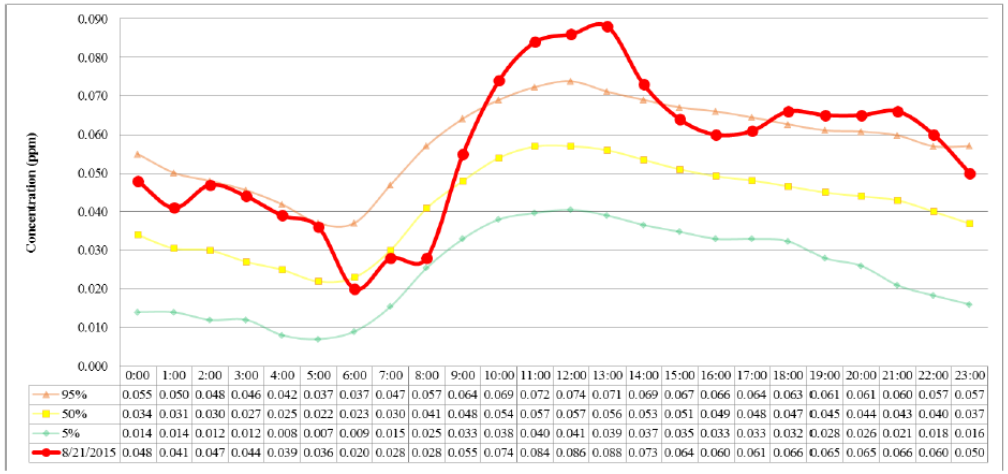


Figure 3.3: Percentiles for Hourly Seasonal Ozone for 2010-2014 with August 21, 2015

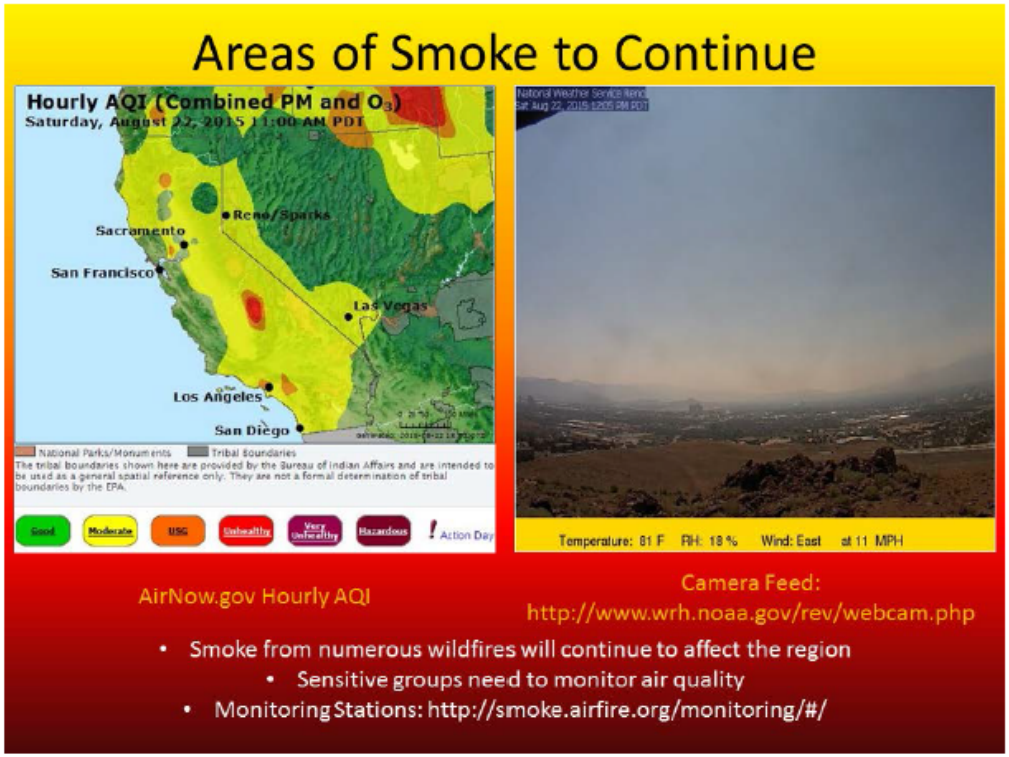


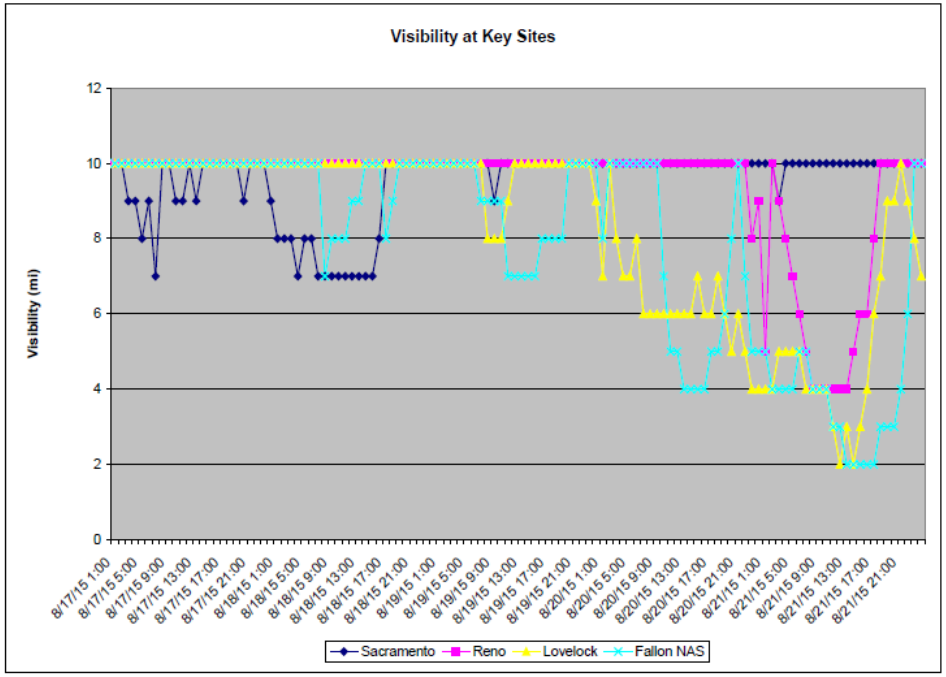
	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
95%	0.055	0.050	0.048	0.046	0.042	0.037	0.037	0.047	0.057	0.064	0.069	0.072	0.074	0.071	0.069	0.067	0.066	0.064	0.063	0.061	0.061	0.060	0.057	0.057
50%	0.034	0.031	0.030	0.027	0.025	0.022	0.023	0.030	0.041	0.048	0.054	0.057	0.057	0.056	0.053	0.051	0.049	0.048	0.047	0.045	0.044	0.043	0.040	0.037
5%	0.014	0.014	0.012	0.012	0.008	0.007	0.009	0.015	0.025	0.033	0.038	0.040	0.041	0.039	0.037	0.035	0.033	0.033	0.032	0.028	0.026	0.021	0.018	0.016
8/21/2015	0.048	0.041	0.047	0.044	0.039	0.036	0.020	0.028	0.028	0.055	0.074	0.084	0.086	0.088	0.073	0.064	0.060	0.061	0.066	0.065	0.065	0.066	0.060	0.050

For illustration and discussion purposes only

Clear Causal Relationship: Tier II, (2)(b)

Figure 2.18: National Weather Service Weather Story from August 22, 2015





For illustration and discussion purposes only

Tier III

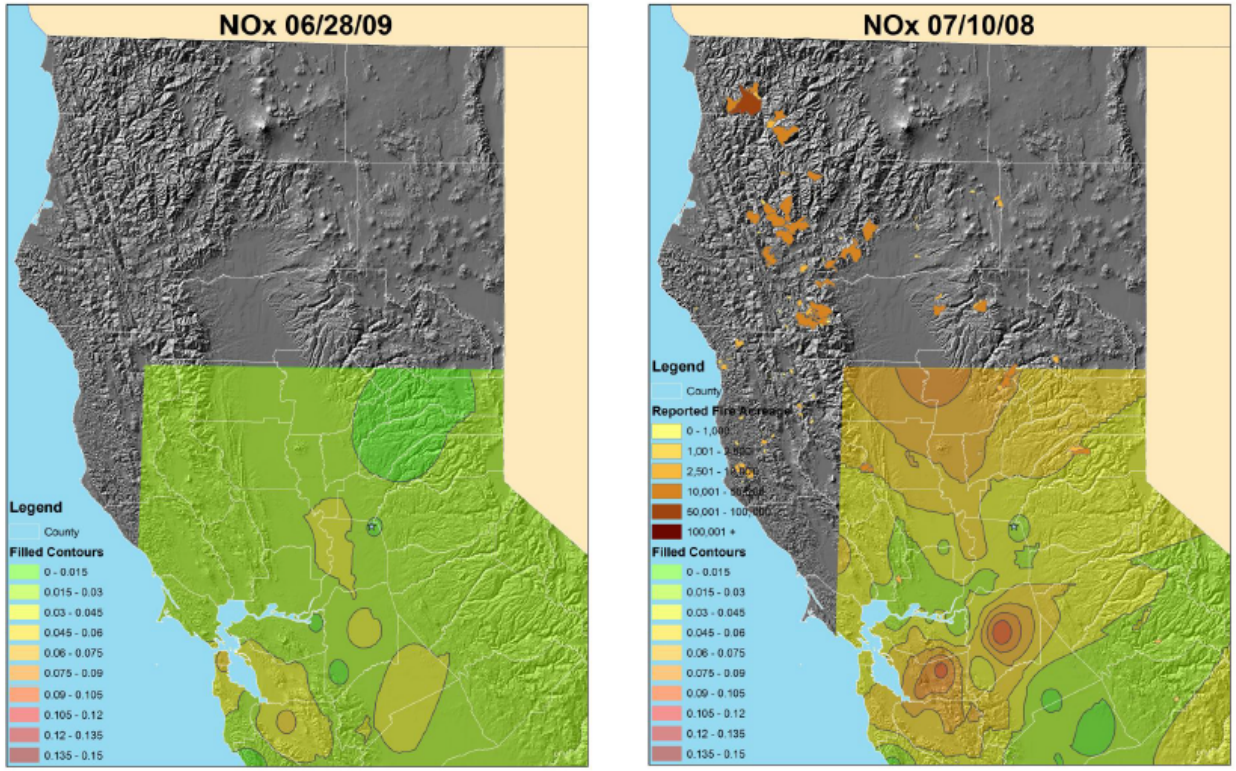
Wildfire events that do not meet the criteria of Tier II

(1) Tier I Analysis
(2) Tier II Analysis
(3) Additional Analysis to Support the Clear Causal Relationship
   a) Comparison of O_3 concentrations on Meteorologically Similar Days (Matching Day Analysis)
   b) Statistical Regression Modeling
   c) Photochemical Modeling

For illustration and discussion purposes only

Clear Causal Relationship: Tier III

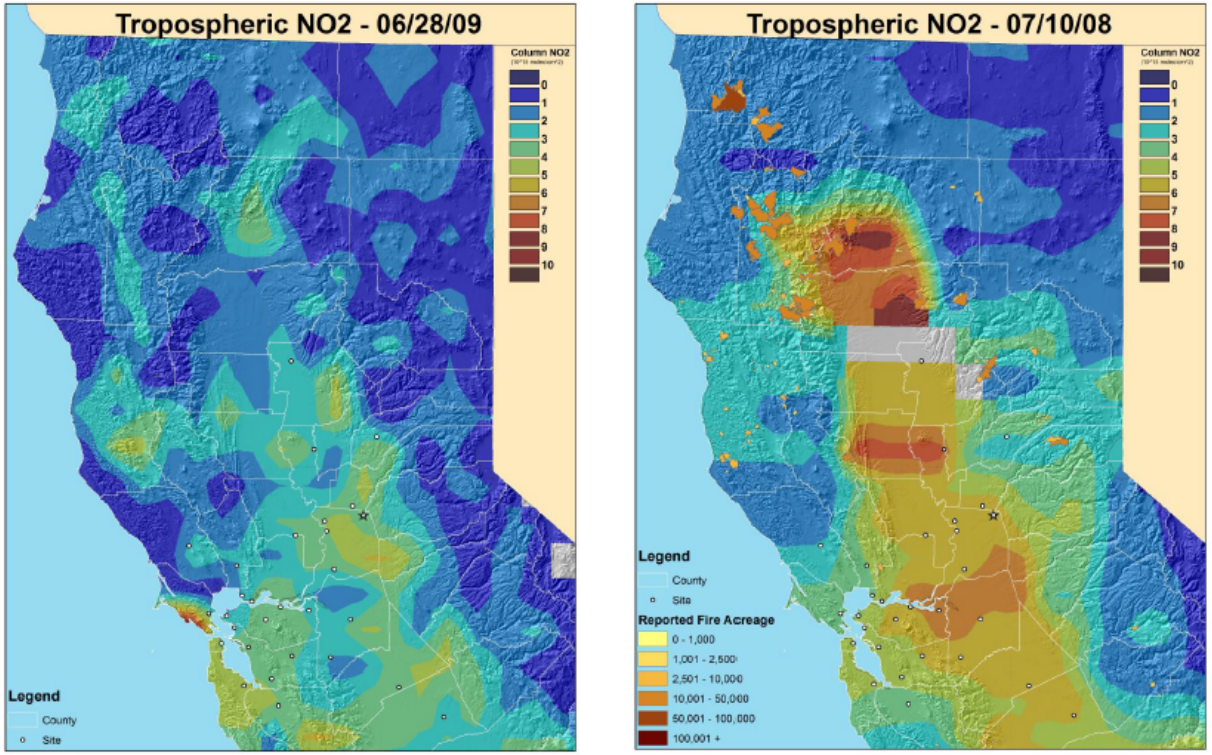
Maximum 1-hour Surface NO_x Concentrations on Surrogate and Fire Days



For illustration and discussion purposes only

Clear Causal Relationship: Tier III

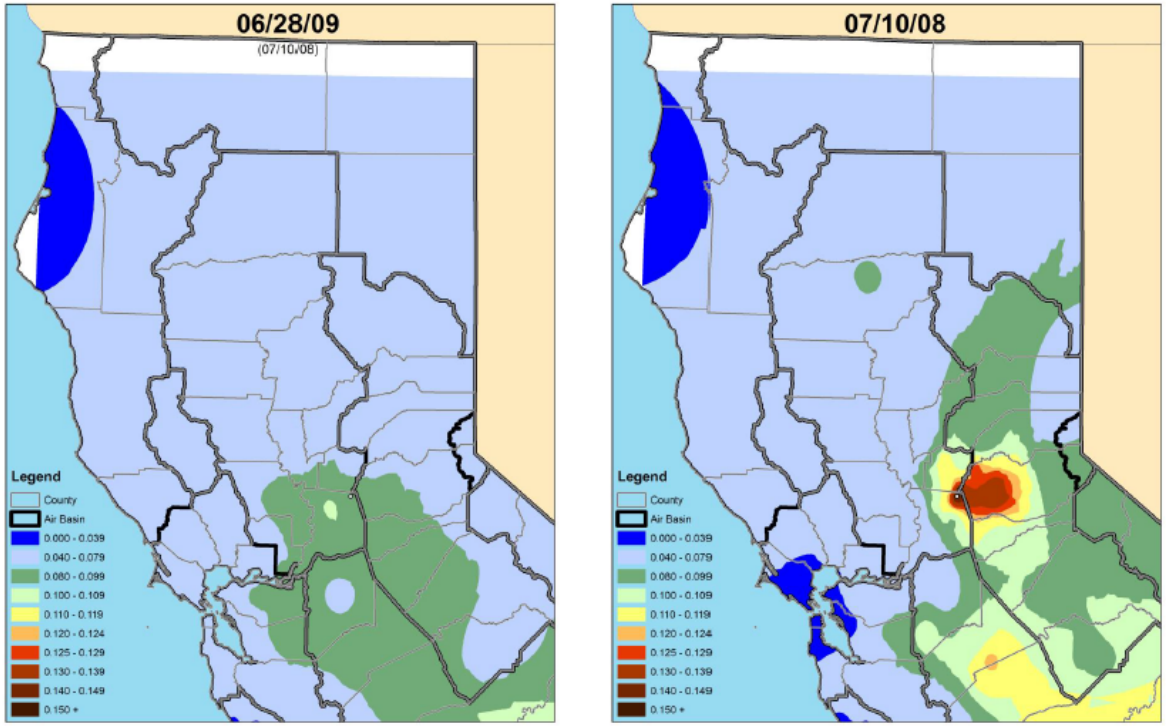
Tropospheric NO_2 Concentrations on Surrogate and Fire Days



For illustration and discussion purposes only

Clear Causal Relationship: Tier III

Maximum 1-hour Ozone Concentrations on Surrogate and Fire Days



For illustration and discussion purposes only

Questions and Comments